

# Analysis of annual budgeting method at Barrick Lumwana Mine

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**Abstract:** Barrick Lumwana Mine is a bulk, open pit, copper mining operation with huge operating and capital sustaining costs. Requiring huge operating capital and cost by nature, which must be prepared and ready before any production year begins, financial planning and budgeting for the mine gets complex due to constantly changing economies and markets which becomes challenging, hence must be reviewed regularly. Understanding the budgeting methods that exist gives a better approach in the selection of which method best suits the mine for effective financial planning through budgeting. It is for this reason that the budgeting method and process at Barrick Lumwana Mine needs to be regularly reviewed. This study set out to analyse the budgeting method used at the mine and determine its suitability in relation to the budget cost variances that had been observed in the recent past, hence determine a suitable budgeting method to be used for better financial planning and allocation of resources. This study is of benefit to Barrick Lumwana Mine and any other mining company that shares a similar nature in operations in understanding the budgeting methods that exist and their application in the real world of mining.

**Keywords:** Budget, Budgeting, Budgeting Methods, Cost drivers, Cost variance, Financial Plan, Mining.

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## 1. INTRODUCTION

With the ever changing global and market economics, Barrick Lumwana Mine as a price taker business must ensure is in control of its financials and is operating efficiently especially through the management of operations and their costs. Therefore, the business must regularly review its financials and processes to stay relevant and profitable in the competitive market. In the recent past five years, Barrick Lumwana Mine has been facing cost variances between budget and actual performance, mostly being negative variances thereby affecting how the company allocates and utilizes resources for continuity of production (Site Management Report (SMR), 2022). There is need to investigate the causes of these variances and mitigate or eliminate them. Therefore, the objectives of this research focused on analyzing the budgeting method currently being used, determining the main cost drivers and recommend a suitable budgeting method to be used at Barrick Lumwana Mine (BLM) for the preparation of annual budgets which should result in minimal to no variance at the end of each financial year.

## 2. LITERATURE REVIEW

There had been no such or similar research done at BLM, making this primary research and relied on primary data collection methods using company reports, and interviews. Also, due to the lack of credible academic write up and literature review on selection of suitable budgeting methods for mining companies, secondary data reviewed included literature on budgeting methods that commonly exist and major cost drivers in mining. While there are many budgeting methods that exist and every company has its unique nature and way of doing business, making them select their appropriate budgeting method. There are four primary budgeting methods used to create an annual operating budget in a business and these are Incremental, Value Proposition, Activity-Based and Zero-Based budgeting methods.

Incremental budgeting also called traditional budgeting method is prepared by taking the previous year's budget, current period's budget or actual performance as a base and add or subtract incremental or decremental amounts as adjustments to

form a new budget for the following financial period (Ouassini, 2018). These adjustments are made on basis factors such as historical percentage change, inflation, market growth, new developments, capacity of production, exchange rates, planned increases or decreases in sales, prices and costs (ACCA, 2022; Finance Management, 2022). However, there has been a notable surge in recent years in criticism of traditional budgeting as researchers believe that traditional budgeting is a relic of the past since it cannot keep up with the changes and demands of today's business environment as such alternative budgeting methods like forecasting, activity-based budgeting, and beyond budgeting, were created as a solution (Cardos, 2014). It was passionately contended that traditional budgeting was outdated and uninteresting since it frequently resulted in dysfunctional behavior among employees, affected the organization's flexibility and adaptation in any given business setting or in a competitive business environment (Asogwa & Etini, 2017).

Value proposition budgeting method is well all about value as it aims to analyse whether a budget item's value outweighs its cost and is used to justify expenses by looking for the value they create in a business if incurred (Denise, 2021). Budgets must be maximized in areas that produce significant outcomes while minimizing costs that ultimately do not add value to the business enterprise, as such, spending plans must be detailed and justified (Gowda, 2021). Datarails (2022) highlights that value proposition budgeting method can take time because it requires understanding the impact of each expense to value and sometimes, this is subjective and impossible to quantify. Because value is unfortunately difficult to measure and without clear understanding, some decisions could result in short-term activities that have a negative influence on long-term strategies (Divvy, 2022). Furthermore, value is always subject to change depending on a variety of factors, including social, economic, and technological ones.

Studying different activity types and how they relate to accomplishing strategic goals is the main objective of activity-based budgeting. The process of planning and managing an organization's expected activities to generate a budget that is both efficient and satisfies anticipated workload is known as activity-based budgeting (Kulova, 2016). The main objective for most businesses is to create value in the competitive and pressured business environment of today and having a budget and accounting system that supports long-term goals is essential for attaining this (Kulova, 2016). Activity-based costing and budgeting was developed in recent years because of the failure of traditional costing methods to accurately track activities across the service and production processes and provide data on costs for both goods and services (Jewdokimow, 2013, pp. 6-7). Similarly, Căpușeanu, Boca, Barbu, Rof and Topor (2013) echoed that activity-based budgeting is observed among the business entities applying it by the substitution of the traditional budget cycle and following the critiques brought to the budget practices used in the traditional methods, therefore, activity-based budgeting method represents a very useful instrument, necessary for the management, coordination, and harmonization of the activities within a business entity.

With zero-based budgeting, the budgeting process begins with a base of zero and makes no reference to the budget or performance of the previous period, such that all budget headings start with a balance of zero, after that, every departmental function is thoroughly examined, and all expenditures rather than merely incremental or projected expenditures require approval (ACCA, 2022). Unless it can be justified and a continuing need is identified, an item that was in the budget last year does not necessarily need to be in it going forward, which is an excellent method for eliminating unnecessary expenses and identifying key expenses that the company cannot live without (Denise, 2021). Zero-based budgeting is a valuable tool for guiding businesses toward more efficient use of both their financial and non-financial resources, which when used, it places an obligation on every business to reevaluate its operations every year starting from scratch (Singh, 2016). Also, zero-based budgeting is best suited for addressing discretionary costs rather than essential operating costs, however, it can be an extremely time-consuming approach, so many companies only use this approach occasionally (CFI, 2022).

Every decision in the business world needs to be cost benefit analyzed. Businesses may maintain a thorough record of the factors that influence costs, or cost drivers, to keep track on their finances, as such, cost drivers are a crucial part of business finance since they enable businesses to forecast their earnings. A cost driver can be defined as a variable that causes a change in the costs as the cost driver changes, meaning, it is a variable that affects your business's expenses and must be a measurable input that affects the costs of a company, either directly or indirectly (Tamplin, 2022; Accounting Tools, 2022). According to Estermann and Claeys-Kulik (2013), a cost driver is any factor that causes a change in the cost of an activity resulting in the activity which consumes fewer or greater amounts of resources. It is the factor which generates occurrence of the consumption of resource (capacity) expenses based on their underlying triggers of the activity, hence, the strategic and accounting purpose of a cost driver implies the factor which causes or produces a change at the cost level and changes the nature of costs to be allocated Cokins and Capusneanu (2010). In hard rock open pit mining operations and companies, there are several activities that are directly linked to cost drivers and form the basis for the calculation and estimation of costs. These activities are the major cost contributing elements to the overall cost of the mine. Such activities include,

labour, overburden stripping, grade control drilling, production drilling, blasting, dewatering, excavating (mining/loading), transportation (hauling), crushing, milling, processing, equipment and plant maintenance, equipment, plant and machinery purchasing or upgrading (SRK Consulting, 2016; Sontamino & Drebenstedt, 2013).

### 3. RESEARCH METHODOLOGY

This research was centered on exploring the processes and approaches used in preparing BLM budget to understand the budgeting process before recommending a suitable budgeting method for the mine that can minimize cost variance. Therefore, exploratory qualitative research was conducted collecting data through semi structured interviews and review of company documents and reports as this was primary study. The target population included the Senior Management employees from which a sample of six participants representing three major departments at the mine were selected through purposive sampling. The three departments are Mining, Mineral Processing and General and Administration departments. The participant (PT) profiles are as summarized in in Table 1. To draw analyses and conclusions from the research data, content analysis method was used and due to lack of data analysis software by the researcher, the data was manually analyzed.

**Table 1. Participant profiles.**

Department	G&A	Mining				Mineral Processing
Section	Finance	Mining operations	Geology drilling	Geometallurgy	Engineering	Mineral Processing
Participant	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6

Source: Research Data Collection 2022

### 4. RESEARCH RESULTS AND FINDINGS

#### 4.1 Budgeting Methods Used at Barrick Lumwana Mine

The budgeting method used in the respective sections and departments of the mine according to participant responses are tabulated in Table 2. Two methods stood out as methods that are dominantly used in the different sections and departments represented by the participants. The mining and process departments through PT 2 to 6 dominantly use activity budgeting method while the G&A dominantly use the incremental budgeting method to prepare their budgets. Each participant went on to explain why they used a particular budgeting method in their section.

**Table 2. Budgeting method used at Barrick Lumwana Mine.**

Summary of interview findings on the budgeting method used at the mine							
	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	TOTAL
What budgeting method is used at Barrick Lumwana Mine to prepare an annual budget?							
Incremental budgeting method	✓	✓			✓		3
Value proposition budgeting method							0
Activity-based budgeting method		✓	✓	✓	✓	✓	5
Zero-based budgeting method	✓						1
Traditional budgeting method							0

Source: Research Data Collection 2022

The Mining Operations section through PT 2 stated that “the dominant budgeting method used in budget preparations is the activity-based budgeting method. This method is used because the budget is dependent on the mine plan which is elaborated by the activities and tasks that are to take place to mine material to different destinations and deliver ore to the processing plant. These activities include oxide material stripping, drilling and blasting of hard rock, loading, and hauling of material by excavators and haul trucks, water management and many more.” The amount or the extent of these activities is dependent on the total tonnes to be mined, geotechnical strength of the material, its geological composition, metal target to be produced and the mining unit cost and price given as guidance from corporate. All the above activities are major cost driving activities which form the foundation of the departmental cost. Oxide material stripping is allocated to contractors hence attracts contractor charges. Therefore, “contract charges in mining use incremental budgeting method because it depends on the

contractor rate provided by the contractor every year and in the contractual agreements. Overall, as mining operations section, the budgeting method used is activity based with incremental budgeting method for contractor charges only” stated PT 2. The Geological Drilling Projects section through PT 3 stated that “the dominant budgeting method used in budget preparations is the activity-based budgeting method. This is because the main activity of this section is grade control drilling for mineral resource definition and confirmation. The drilling activity produces drill cores or chips that must be sent to geo-metallurgy for analysis and mineral occurrence determination and estimations.” The extent of drilling is dependent on the area to be covered by the mine plan. It is for this reason that the section uses activity budgeting method for budget preparations and estimations. The Geo-Metallurgy analysis section through PT 4 stated that “the dominant budgeting method used in budget preparations is the activity-based budgeting method.” The primary responsibility of this section is drill core sample analysis for mineralization. “This activity entirely depends on the samples obtained from the Geological Drilling Projects. More samples and drill coverage imply more analyses to be done hence more costs to be incurred. That is why the section uses activity budgeting method for budget preparations and estimations.” The Engineering section responsible for equipment, machinery and plant reliability and maintenance through PT 5 stated that “the dominant budgeting method used in budget preparations is the activity-based budgeting method, but incremental budgeting method is used too for minor entries. The main activities of this section include servicing, repair and maintenance of equipment and machinery, major component changeout or equipment replacement. These activities differ yearly based on the mine plan demand equipment hours and equipment life (servicing or major component changeout), therefore, activity-based budgeting is suitable for the department and it is why the method used.” Because the mine deals with different makes and brands of equipment and machinery, there is need for expert and support services from equipment and machinery manufacturers and vendors which attracts contractors and contractor charges. Therefore, the section also uses incremental budgeting method for contractor charges only. It is clear and evident that overall, mining department dominantly uses the activity-based budgeting method because it is activity driven in nature but also uses incremental for contractor charges only. The Mineral Processing Department through PT 6 stated that “the dominant budgeting method used in budget preparations is the activity-based budgeting method.” This department is responsible for crushing and milling ore material that it receives from the mining department and processing it into copper concentrate through a series of mechanical and chemical processes. “All the processes and activities from milling to the production of copper concentrate depend on the ore tonnes material to be milled as per mine plan. The more ore tonnes to be milled, the more costs to be incurred. Therefore, this department’s costs depend on the ore tonnes to be milled and the activities that follow, making activity-based budgeting method suitable for use in the department.” The G&A Department through PT 1 highlighted that “the dominant budgeting method used in budget preparations is incremental budgeting method.” G&A department is made up of all support sections including Humana Resource, Health, Security, Sustainability, Lumwana Property and Development Company, Camp Services, Information Technology, Supply Chain, Commercial and Marketing. All these sections offer support services and labor to the primary departments and costs incurred are not directly linked to a specific activity but rather highly depends on the price escalations and salary increments.

Speaking overall for the Finance section whose responsibility is to oversee BLM’s financial status and overall mine budget, PT 1 stated that “the overall budgeting method used at BLM as a company is the incremental budgeting method. The nature of the business being a large sized mining entity with a formal structure of the business, being a producer of one commodity to specific customers for the commodity and having been in production for over 15 years with proper financial history and records, incremental budgeting method is suitable for use” said PT 1. The other reason is that “all primary mine activities remain the same for as long as the mine is operational even though these activities may differ in magnitude yearly based on the mine plan. However, individual sections may use activity based in their cost estimations as they are more detailed, and activity driven.” PT 1 went on to explain that the third reason incremental budgeting method is used for overall budgeting is that it can be adjusted and controlled to meet the company unit cost target set by corporate for the mine site. “Every year, the mine receives corporate guidance on target unit costs and price escalations to remain profitable as a business.” These targets are set at Barrick Group level looking at the group strategy, global economic activities, expected inflation, price escalations and commodity price (Copper price) and company profitability. Because of these reasons the budgeting process at BLM is Iterative and repetitive. “Overall, incremental budgeting method is used to prepare the final BLM annual budget.”

#### **4.2 Main Cost Drivers at Barrick Lumwana Mine**

All participants were asked to state the main cost drivers in their sections and the responses are summarized in Table 3. The results show that each department or section has at least two cost drivers which are generated from the departments primary activities and responsibilities or services. A cost driver as defined earlier in the study is a variable that causes a change in the costs as it changes, affecting a business’s expenses either directly or indirectly. For BLM, there are six main cost drivers

namely equipment hours, tonnes mined, meters drilled, volumes blasted, tonnes milled, and labor spread across all departments. Cost drivers are used to determine the consumables and commodity quantities required and these are obtained from the cost driving activities. In mining department represented by PT 2 - 5, the main cost driving activities include “labor, overburden stripping, grade control drilling, production drilling, blasting, excavating (mining/loading) and transportation” and all these activities require equipment and machinery as the mine is highly mechanized. These activities generate cost drivers namely “equipment hours, tonnes mined, meters drilled, volumes blasted, tonnes milled and labor. These cost drivers are used to calculate major cost components for the department in consumables and commodities arriving at fuel costs, equipment cost, tire costs, labor costs, drilling consumables costs, explosives costs and contractor charges for mining department.” These costs increase with the increase of tonnage to be mined and reduce when there is a reduction in tonnes mined. In mineral processing department represented by PT 6, the

**Table 3. Main cost drivers at Barrick Lumwana Mine.**

Summary of interview findings on the main cost drivers in each section						
	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6
What are the main cost drivers at Barrick Lumwana Mine?						
Equipment hours	✓	✓	✓	✓	✓	✓
Tonnes mined	✓	✓				
Meters drilled	✓	✓	✓	✓		
Volume blasted	✓	✓				
Tonnes milled	✓					✓
Labor	✓	✓			✓	
Total	6	5	2	2	2	2

Source: Research Data Collection 2022

main cost driving activity is the “milling of ore tonnes to resize them for chemical processing. This activity depends on the ore tonnes mined and crushed by the mining department and generates and drives the departments main cost elements being labor, plant maintenance and mechanical component costs, electricity costs, grinding media and mill liners costs and chemical reagent costs.” All these costs are inevitable to the production of copper concentrate from copper ore tonnes milled and these costs increase with the increment in mill tonnes. In G&A department, represented by PT 1, “the main cost components are the labor cost and camp management costs these are dependent on the number of employees that are on rosters and are offered temporal accommodation and living services required.” Because majority of labor is on permanent employment contracts, there is little change in employee numbers which makes the number almost the same year in year out. Much of the increment in costs for this departments comes from change in regulatory or statutory requirements and obligations and salary increments that take place yearly.

Overall, the major cost components that have significant impact on the overall mine budget as stated by Finance Department through PT 1 are “fuel costs, tire costs, explosive costs, grade control drilling costs, equipment and plant service costs, major component changeout costs from mining department, grinding media costs, electricity costs and chemical reagents costs for mineral processing department and finally camp management costs for G&A department.” In percentage contribution to overall production costs, Mining department accounts for 60%, mineral processing department accounts for 30% and G&A department contributes the remaining 10% (SMR, 2022)

### 4.3 Budget Cost Variance

A budget cost variance is the difference between the cost actually incurred and the budgeted cost that should have been incurred and these cost variances are commonly tracked for expense line items or at a job or project level (Accounting tools, 2022). Because BLM is not an ideal business, just like any other, it experiences cost variances. Despite this being the case, there is “no variance tolerance is allowable, and each department must ensure zero variance at the end of each financial year or better still a cost variance of less incurred costs than planned but achieving all the production targets.” This however has been the opposite at BLM for an average of five years. All participants were asked to state the cost variances of their departments and they referred to finance department for the variances. Therefore, the variances for the past five years as collected from Finance for the three departments are tabulated in Table 4. All variances in red font are costs above budget and those in green are below budget costs in Table 4. From Table 4, the average variance is 15% above the budgeted cost for the five-year period. Yearly, this is the trend except for 2019 which had less costs than

**Table 4. Barrick Lumwana Mine budget cost variance by year.**

Unit Cost Variance	2017	2018	2019	2020	2021	5 YEARS
Mining Department	15%	60%	-13%	7%	30%	20%
Mineral Processing Department	26%	24%	-5%	-11%	4%	8%
G&A Department	23%	42%	-14%	1%	-2%	10%
<b>OVERALL VARIANCE</b>	<b>18%</b>	<b>48%</b>	<b>-12%</b>	<b>1%</b>	<b>20%</b>	<b>15%</b>

Source: Site Management Report (SMR) 2022.

planned. When asked to help explain what caused such high-cost variances, all participants referred to “the budgeting process being one of the major contributors to the variances as the cost adjustments made to meet the corporate target unit cost do not match the underlying principle and budgeting method that is relevant in each department supported by its nature and activities to help estimate future costs for a specific mine plan. Also, failure to achieve the mine plan by not achieving the planned material to be mined and processed, which can happen due to various reasons.” These responses shaded light into the direction of a possible solution to minimize the cost variances as they are unwanted in any business.

#### 4.4 Recommendation of a Suitable Budgeting Method by Participants

The last question of the interview asked participants to suggest which budgeting method to be used at the mine overall. Their responses are tabulated in Table 5.

**Table 5. Recommended budgeting method to be used at Barrick Lumwana Mine.**

Summary of interview findings on the recommended budgeting method to be used at Barrick Lumwana Mine by participants							
	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	TOTAL
What method would you recommend being used at Barrick Lumwana Mine for preparing annual budgets?							
Incremental budgeting method	✓	✓			✓		3
Value proposition budgeting method							0
Activity based budgeting method		✓	✓	✓	✓	✓	5
Zero based budgeting method							0
Traditional budgeting method							0

Source: Research Data Collection 2022

As shown in Table 5, both mining and process departments recommended the use of activity budgeting method for all cost estimations because they are activity driven and only use incremental budgeting method for contractor charges only. G&A and Finance department recommended the use of incremental budgeting method for cost estimations and alignment to cooperate target, and this is because the departments are not activity driven but are dependent on economic factors.

## 5. RESEARCH DISCUSSION

In the quest to determine and analyze the current budgeting method used at BLM there is need to look at the budgeting process in detail as all the participants have stated what method is used in their respective departments and the finance department stated that the overall budgeting method used is incremental budgeting method. The budgeting process at BLM begins with the individual departments preparing budgets using their respective budgeting methods as stated earlier and submitting their budgets to finance department for consolidation and calculation of unit cost of production for the entire mine and comparison to the corporate guidance target unit cost for the mine. The first submissions always result in a higher unit cost than the target unit cost. When this happens, the finance department then reviews previous year’s budget performance and project future costs in planning based on price escalations and production increment percentage if any and requests all the departments whose budgets are above the projections to adjust their budget. This process continues until all the departmental costs are in line with the incremental projections made by the Finance department and when consolidated, the unit cost achieved is in line with the corporate target unit cost given for the site. These costs are then set and locked in as budget for the mine and are submitted to corporate (Barrick group). All the participants confirmed this iterative, interactive, and repetitive procedure when preparing the budget and is known as the budgeting process. This process takes about three to four months from the start to completion and approval. This process clearly shows that the overall budgeting method that is used to arrive at an approved budget that is in line with corporate guidance for mine profitability is

incremental budgeting method despite the initial submissions of separate departments dominantly using activity-based budgeting method.

The major cost drivers which generate the major cost components of the mine have been clearly highlighted to be equipment hours, tonnes mined, meters drilled, volumes blasted, tonnes milled and labor for BLM and these drivers are obtained from the production activities that flow from the open pit mine to the process plant and eventually to the market. Overall, the major cost components of the budget include fuel costs, tire costs, explosive costs, grade control drilling costs, equipment and plant service costs, major component changeout costs, grinding media costs, electricity costs and chemical reagents costs and camp management costs.

Even though the overall budgeting method used at BLM is Incremental budgeting method, the participants' responses and justifications highlighted that there is high demand and recommendation to use the activity-based budgeting method instead for annual budgeting, a recommendation not supported by the Finance section through PT 1. Therefore, to determine which budgeting method suits better for use at the mine, there is need to compare their characteristics and application. The use of incremental budgeting method on site was supported by characteristics that warrant its use in an organization being the nature and large sized mining entity with a formal business structure, being a producer of one commodity (copper concentrate) to specific customers for the commodity and having been in production for over 15 years with proper financial history and records. Also, the method is easy to use and less time consuming and it can be adjusted and controlled to meet the company unit cost target set by corporate for the mine site. All these characteristics fit the application of this method in a business. Incremental budget is prepared by taking the previous year's budget, current period's budget or actual performance as a base and add or subtract incremental or decremental amounts as adjustments to form a new budget for the following financial period (Ouassini, 2018). This definition supports use of the method at the mine as it has been in existence for a long period and can track its financial records. ACCA (2022) and Finance Management (2022) explain that in preparation of a budget using incremental budgeting method, cost adjustments can be made using factors such as historical percentage change, inflation, market growth, new developments, capacity of production, exchange rates, planned increases or decreases in sales, prices, and costs. Pietrzak (2013) explains that businesses choose to adjust incremental budgeting and adapt it to management demands with the potential use of other budgeting methods rather than completely abandon it due to its simplicity. These published reviews support the reasons incremental budgeting has been used at BLM in line with the reasons PT 1 stated and that is why during budget adjustments to target the guided unit cost by corporate, previous year's plan and actuals are used as the base case and further adjustments being based on percentage production increment or decrement, inflation or price escalations are applied and regarded standard for the budgeting process and budget at BLM. However, literature shows that there has been a notable rush in recent years in criticism of incremental budgeting as it believed to be is a relic of the past since it cannot keep up with the changes and demands of today's or future's business environment as such alternative budgeting methods like forecasting and activity-based budgeting, were created as a solution (Cardos, 2014). Similarly, PT 2-6 support the use of activity-based budgeting method in relation to Cardos as it is much forward looking than past referencing. As explained by the participants under mining and mineral processing departments, the production of copper concentrate from the mineral reserves takes a series of detailed and inevitable activities which without, there will be no production of copper concentrate at all and BLM will not be a mining business. In line with this Kulova (2016) says the activity-based budgeting method assigns activity costs to cost objects based on the activities that the cost objects required, therefore, assigns resource costs to activities based on the resource utilization of business activities. Unlike other methods, activity-based method focuses on the expected output implying that it looks at the future desired results and set up all necessary resources and activities to ensure the future result is achieved. Huynh, Gong & Huynh (2013) state that there are four steps required to prepare a budget using activity-based budgeting method and these are; determining the objective, goal and output of a business, identifying activities needed to deliver outputs together with their driving factors, estimate the demand for each activity and finally, determine the cost and resources required to produce and carryout the relevant activities. This relates with the budgeting process at BLM at departmental level before any cost adjustments are done. Just like there is guidance from corporate on what the target unit cost is, there is guidance too on how many copper pounds should be produced in the budget year. This target is usually given as a range and therefore, a mine plan must be developed to produce that target copper. The mine plan generates all quantities of physicals and cost drivers as well activities required to arrive at the target metal. This mine plan is distributed to all departments for cost estimations and calculations based on the cost driving quantities and cost drivers. Every department then works out in detail what activities and how much of the activities need to take place to achieve the target and how much it would cost. Every year, the activities vary in magnitude and composition. This is because of the differences that happen at any stage of the mine in terms of the geotechnical strength of material being mined and the geological and mineral composition of material which will vary the drill meters, volume to be blasted and amount of explosives required, the increasing pit depth and waste dump height as

mining progresses results in longer cycle times hence equipment hours increase, fuel required increases, more tires are required and equipment gets to age and becomes more costly to maintain though less reliable. The geotechnical strength and mineral composition of material also changes what the mill plant costs will be because it affects the life of grinding media and mill liners, chemical reagents vary too, mechanical components vary as well and finally the mineral recovery varies too. Therefore, mining and processing one tonne of material will not be the same in each production year and cannot be linearly or projected using past performance or future inflation, price escalation or increase in quantity due to the reasons and characteristics explained. It is for this reason that there is need to use activity-based budgeting method when preparing the mine's annual budget as all the major cost drivers and cost entries stem from the activities that are needed in production. The method is great for businesses that are undergoing a lot of material changes where historical information may no longer be a useful basis for future budgeting (Denise, 2021). Activity-based budgeting method will most likely produce realistic costs hence result in less budget cost variance for the mine as it is activity driven, forward looking and dynamic. Looking at the past financial performance of the mine in relation to the budgeting method used there is reasonable evidence that incremental budgeting method being used could contribute to the increased budget cost variance especially with the gap in the cost estimations as highlighted. There is need to test and see the use of a different budgeting method in this case being activity-based budgeting method for the preparation of BLM's annual budget and minimize the annual budget cost variance for better financial planning. In Romania, at Lupeni Mining Exploitation, activity-based budgeting method was implemented and recommended for use in extraction industries as the method assesses the volume of activities, considers activity inductors, resources and their sizing thereby terming the method as an instrument of simulation at a global level, regarding the assignment or reassignment of resources necessary for performing activities and obtaining production (Căpușneanu, Boca, Barbu, Rof & Topor, 2013). Therefore, it is recommended that the suitable budgeting method for preparing annual budgets at Barrick Lumwana Mine according to literature reviewed and research findings is activity-based budgeting.

## 6. CONCLUSION

The overall budgeting method currently used at BLM is incremental budgeting method. This is seen in the iterative process of budgeting which begins with preparation of departmental budgets using activity-based budgeting method to estimate costs and then adjusted to meet the target unit cost of production by referring to the previous budget or actuals and hence projecting costs based on percentage increment or decrement in production in the new plan and expected price escalations hence adopted as mine budget.

The study of the major cost driving activities that take place at the mine to mine and process material to produce copper concentrate helped determine the main cost drivers at BLM being equipment hours, tonnes mined, meters drilled, volume blasted, tonnes milled and labor, achieving the second objective. Knowing the cost drivers assisted in determining a suitable budgeting method to be used at the mine because they formed the basis and principles on which cost estimations and adjustments should be made.

To determine the suitable budgeting method to use at BLM, analysis of the current budgeting method, budgeting process, corporate guidance, cost drivers and activities, and causes of cost variance was done and the suitable budgeting method was concluded to be activity-based budgeting method for the preparation of annual budgeting method for Barrick Lumwana Mine for better resource management and less budget cost variance as the final objective of the research. This is because the current budgeting method being used has resulted in high budget cost variances and secondly, all the major cost entries are directly activity based and greatly vary with change in the activity. Therefore, cost estimations made through activity-based budgeting method will give a realistic expectation of financial performance and position of the mine hence reducing budget cost variance. This will result in effective and efficient realization of allocation of resources, continuity of production, realistic reinvestment capital, realistic sustainable capital development, adherence to loan or debt repayment and committed dividends to be paid out without variations, therefore achieving effective and sustainable financial planning and production of Barrick Lumwana Mine. Ultimately, the objective of the research was met.

## 7. RECOMMENDATIONS

The research shows that there is a strong relationship between the budgeting method used for cost assumptions and estimations and the magnitude of cost variance to be incurred. The nature of the business should guide what a suitable budgeting method would be for realistic cost estimations. Therefore, for better financial planning and reduction of cost variance, Barrick Lumwana Mine as a business should consider implementation of the following recommendations from the research.



Adopt the use of activity-based budgeting method to prepare the mine's annual budgets as the major costs are activity related and dependent. To manage the change and confirm the effectiveness of activity-based budgeting method at the mine, in parallel continue to run the incremental budgeting method and compare the cost variance to the budgets with the actual cost incurred against the two methods.

Investigate and research what inputs, parameters and cost assumptions and price escalations are used at corporate level when determining the target unit cost by Barrick group for the mining sites under the group. Also, these assumptions must relate and be tailored to BLM site as an individual entity and minimize generalization as each site has distinct characteristics and operates in a distinct host country economy despite being under one group company.

During cost adjustments, activity-based method should be used and should take superiority over incremental budgeting method should the mine decide to continue using incremental budgeting method. This is because all major costs components for the mine are dependent on the operations and production activities and these activities are not linearly related to cost assumptions as would simply be done in incremental costs. Also, if the costs cannot be adjusted as required, consider optimizing or changing the mine plan too to match up to the unit cost being targeted.

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